Teacher Tool 747: Program Guide for

Full STEAM Ahead with Programming Robots

Educate.Today

Innovate · Illuminate · Inspire

Educate.Today

Full STEAM Ahead with Robots

Original Program Date: October 17, 2019
Grade Levels: 7-12

Program Description:
With robots now able to do everything from exploring space to mowing your lawn, the ability to write code and program robots provides more interesting engineering challenges and career opportunities than ever. In this interactive program, students take on the role of a computer programmer as they attempt to meet the following scenario:

You have just landed your 2-wheel Mars Crawler on the southern edge of the Arabia Terra. It's time to set up communications with Earth. Proximity sensors tell the Crawler (named Vagabond or Bondi) that it is in the shadow of a crater wall. This sensor data triggers a request for a program that will move Bondi 2 meters south and 3 meters west to be out of the crater wall's shadow. The program also has to orient Bondi's communications antenna so that it is pointed straight up in the sky, towards Earth. It is your job to write a program that Bondi can run to properly orient the Crawler for successful Earth communications. Additional scenario details to help you determine possible program commands to offer and possible questions to ask during the program are available in the Pre-Program Activity Suggestions section of this document.

In addition, students also interact with Siinya Williams, Senior Director of Community Science at the Saint Louis Science Center to learn more about careers related to robots, computer programming, coding, and engineering and to learn about the importance of teamwork and collaboration in solving an engineering problem.

Program Objectives:
1. The participant will learn about the importance of teamwork and collaboration in solving an engineering problem.
2. The participant will think like an engineer and a computer programmer.
3. The participant will explore science, technology, engineering, and math used to plan and successfully execute communication with a robot.
4. The participant will engage in critical thinking and creative thinking.

Program Format:
The agenda below provides you the topics to be explored in the program as well as the order of that exploration. Student questions will be woven in throughout the program.

I. Welcome and Introduction—Student groups and experts are introduced and welcomed to the program and given information on ways to interact during the program.

II. Discussing Coding—Mr. Stanard shares examples of the types of coding used in programming robots and answers student questions.

III. Learning More About Careers in the Field—Students meet Siinya Williams to learn more about the Saint Louis Science Center's Community Science and YES programs and to ask their questions about careers in the fields of engineering, robots, and computer programming.

IV. Robot Demonstration: The Mars Crawler Challenge—Students will interact again with Mr. Stanard to engage in the scenario provided above and in the Pre-Program Activity Suggestions section of this document. Students will be able to offer their suggestions for commands and also able to ask questions as they investigate what works and what does not work when trying to meet the objectives of the scenario.

V. Summary and Closing—We summarize the major concepts learned and deal with final questions from students.

Related Activity Suggestions:

1. Mars Robot Scenario: Use the scenario followed in the program to have your students work on coding a robot of their own to meet the same challenge that Mr. Stanard discussed.

You have just landed your 2 wheel Mars Crawler on the southern edge of the Arabia Terra. It's time to set up communications with Earth. Proximity sensors tell the Crawler (named Vagabond or **Bondi**) that it is in the shadow of a crater wall.

This sensor data triggers a request for a program that will move **Bondi** 2 meters south and 3 meters west to be out of the crater wall's shadow. The program also has to orient **Bondi**'s communications antenna so that it is pointed straight up in the sky, towards Earth.

It is your job to write a program that **Bondi** can run to properly orient the Crawler for successful Earth communications. You know the following:

Bondi is facing north.
Bondi's two driving wheels are each 15.9 centimeters (cm) in radius (31.8 cm in diameter)
Bondi's communications antenna is aimed at the horizon to the south; its position = 0. If the antenna were pointed at the horizon to the north, its position would be 1. If it were pointed at the top of the crater, its position would be 0.68

Your possible programming commands **for each wheel** (left and right) are as follows:
Turn 1 revolution forward
Turn 1 revolution backward

You can also send **Bondi** the following commands:
Turn left 90 degrees
Turn right 90 degrees

You can send a command to set the antenna to any position between 0 and 1

Supplemental Resources:
Saint Louis Science Center:
https://www.slsc.org/visit/

Saint Louis Science Center Educator Connections:
https://www.slsc.org/connections/educators/

Saint Louis Science Center YES Program:
https://www.slsc.org/saint-louis-science-centers-youth-exploring-science-program-celebrates-20th-graduating-class/

Featured National Standards:
Common Core Standards for English/Language Arts and Literacy in History/Social Studies, Science and Technical Subjects

College and Career Readiness Anchor Standards for Reading

7. Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.

College and Career Readiness Anchor Standards for Writing

6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

College and Career Readiness Anchor Standards for Speaking and Listening

1. Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.
2. Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

Common Core State Standards Initiative
English Language Arts Standards—Literacy in Science and Technical Subjects
Grades 6-8
Integration of Knowledge and Ideas:
CCSS.ELA-LITERACY.RST.6-8.7
Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
CCSS.ELA-LITERACY.RST.6-8.8
Distinguish among facts, reasoned judgment based on research findings, and speculation in a text.
CCSS.ELA-LITERACY.RST.6-8.9
Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

Grades 9-10
Integration of Knowledge and Ideas:
CCSS.ELA-LITERACY.RST.9-10.7
Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

CCSS.ELA-LITERACY.RST.9-10.8
Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.

Featured National Standards: (Science)
Science as Inquiry - Science as inquiry requires students to combine processes and scientific knowledge with scientific reasoning and critical thinking to develop their understanding of science.

1. Abilities necessary to do scientific inquiry
2. Understandings about scientific inquiry

Next Generation Science Standards
Engineering Design
MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.